Alberta
ENERGY AND
NATURAL RESOURCES

OFFICE OF COAL RESEARCH & TECHNOLOGY

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ALBERTA COAL RESEARCH STRATEGIC PLAN

NOVEMBER, 1983

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Reprinted May 1984

Alberta

GOVERNMENT OF ALBERTA

NEWS RELEASE

FOR IMMEDIATE RELEASE

OFFICE OF COAL RESEARCH AND TECHNOLOGY ESTABLISHED

EDMONTON, FEBRUARY 17, 1984 . . . John Zaozirny, Minister of Energy and Natural Resources, today announced the establishment of an Office of Coal Research and Technology. The purpose of the Office will be to promote and help coordinate the funding of research, development and testing of new technology in support of efforts to expand markets and uses for Alberta's vast coal resources.

Mr. Zaozirny noted that the Office of Coal Research and Technology will focus on developing new or improved commercial technologies which will, during the remainder of this century, (a) enhance the competitiveness of Alberta's coals in international markets; (b) minimize the environmental impact of the production or utilization of coal in Alberta; and (c) result in new uses of Alberta coals.

The Office will work closely with industry and other agencies. Funding of approximately $20 million has been allocated from the Alberta/Canada Energy Resources Research Fund to help provide financial support for approved research projects.

Mr. R.D. McDonald, Executive Director of the Scientific and Engineering Services Division of the Department of Energy and Natural Resources, has been appointed Chairman of the new Office, effective immediately. Mr. Zaozirny stated that other members of the Office will be appointed on a term basis from time to time, and that staff support for the Office will be drawn from existing departmental resources.

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EXECUTIVE SUMMARY

The Alberta Government recognizes the vital role of the private sector in the economic and social development of the Province. It also recognizes the importance of Research and Development (R&D) to the strength of Alberta's economy. Energy and Natural Resources (ENR) has a major responsibility for the orderly development of the natural resources of the Province including coal. Other Departments and Agencies also have certain responsibilities and duties with respect to the development of these resources.

With general support and encouragement of industry, the government of Alberta has provided considerable funding during the past 5 years to expand the coal R&D capability of the province. The strategy for coal R&D presented in this document has been developed by ENR in close collaboration with the coal industry, supplemented by careful consideration of views received from the universities; other relevant Alberta departments and agencies including Economic Development, Environment, Worker's Health and Safety and Compensation, Alberta Research Council (ARC) and Energy Resources Conservation Board (ERCB); Energy, Mines and Resources, Canada (EMR); and the Coal Mining Research Centre (CMRC) with a view to guiding the R&D efforts within the province during the next few years.

The strategy provides a framework within which specific coal R&D activities will be identified and selected to facilitate and foster economic activity and development by the private sector, and which will help ensure the sound management of Alberta's coal resources.

Alberta's coal resources are expected to contribute to Alberta's and Canada's economic development in several different ways, principally:

a) Use within Alberta, primarily as a source of electrical energy, and in support of other energy resource developments such as heavy oil and/or bitumen recovery and upgrading.

b) Exports from the province, largely to international markets, but also to other regions of Canada, as a primary energy source.

c) Contributing to Canada's longer term energy and chemical feedstock requirements.

Certain constraints exist which may limit development and expansion of these opportunities. The nature and location of the higher quality coals suitable for export result in Alberta being a relatively high cost supplier in the international market place. This makes it difficult to compete on the basis of price. Other factors are important including supply reliability and product quality.

The increasing public consciousness regarding the environmental impact of economic development and the need to consider balanced and rational resource development will have consequences for both production and utilization of coal in Alberta.

Aggressive approaches are needed to resolve these problems of quality, cost, and environmental impact if coal development in Alberta is to reach its full potential. The development and commercialization of improved technologies is one approach which must be encouraged. It is believed that an increased level of R&D related to the exploration, recovery, beneficiation, transportation, storage and utilization of coal in a manner that is efficient, economical, safe and environmentally acceptable is required and that concerted action by industry, government and the research community is necessary to stimulate appropriate R&D projects. Whenever possible, such R&D should be done in collaboration with other groups, both nationally and internationally, with similar interests.

The primary goals of this Strategic Plan are to identify, investigate and develop those technologies considered likely to be commercially important in the intermediate time frame from 1988 to 1998 and which will:

a) enhance the competitiveness of Alberta coals in international markets.

b) minimize the environmental impact of the production or utilization of coal in Alberta.

c) result in new uses for Alberta coals.

It is believed that the most effective manner of achieving these goals is by conducting a number of carefully selected projects designed to resolve significant technical and economic issues associated with the development and application of new technologies on a commercial scale in the period 1988-1998. Consideration will be given as to how such projects should be supplemented by research directed toward new and innovative technologies related to further enhancing the use and competitiveness of Alberta coal.

There is clear interest in the private sector in applied R&D related to achieving the goals of this Strategic Plan, although the current financial climate is not conductive to major new financial commitments by individual companies. While general agreement exists as to the problems facing future coal development, no consensus has emerged about which areas should be assigned priority or which specific activities merit study now. However, there appears to be enough agreement to warrant serious consideration being given to joint industry/government funding for projects which demonstrate the commercial potential of:

a) improving the quality and minimizing the cost of Alberta coals for the export market.

b) improving the cleaning of thermal coal and reducing the environmental impact of coal production in the province.

c) developing new uses of Alberta coals including industrial applications and coal liquefaction

d) reducing the environmental emissions associated with combustion of subbituminous coal.

Funding of approximately $20 million has been identified from the Alberta/Canada Energy Resources Research Fund (A/CERRF) to provide a share of the financial support for such projects.

The Office of Coal Research and Technology does not intend to establish an in-house capacity to carry out specific R&D projects. Rather, an applicant whose proposed R&D project is accepted by the Office of Coal Research and Technology will be expected to manage and conduct the project in the manner normal to contracted R&D, within the terms and conditions of a negotiated agreement.

This strategy is intended to support and promote coal R&D in the private sector with the Office of Coal Research and Technology sharing the risks and costs, primarily in situations where the risks or costs are such that they would not be assumed by the private sector alone. Further discussions are required with the Universities and the research institutes, such as ARC and CMRC, toward establishing a framework within which additional research efforts appropriate to developing new and innovative technologies for the longer term future of coal development in the province can be identified, assessed and supported.

With the above in mind, individual companies or groups are encouraged to examine the strategy and related conditions presented in this document and, if they desire, to submit applications for specific R&D projects which fall within its scope.

PART I ALBERTA COAL RESEARCH STRATEGIC PLAN

A. STATEMENT OF PURPOSE

The Government of Alberta looks to the private sector to undertake the initiatives necessary for the successful development, utilization and marketing of the province's coal reserves within the overall framework of the Alberta Coal Development Policy. The Office of Coal Research and Technology believes it can and should play a supporting role to assist the coal industry to pursue desirable initiatives. The two issues considered to be of major importance to the intermediate (5-15 year) development of Alberta's coal reserves are the increasing competition in the international market place and the increasing concern over the environmental impact of coal development and utilization. The development and introduction of new technology leading to higher product quality, lower production and transportation costs, new industrial applications for coal, and reduced environmental impact from both production and utilization of coal can help to overcome these problems and to maximize the economic and social benefits derived from coal development in the province.

In close collaboration with the coal industry, other government departments and agencies, and research organizations, the Office of Coal Research and Technology will undertake certain activities and responsibilities which are intended to expand the scope and level of coal-related R&D in the province. These activities include:

(a) preparing, and updating as appropriate, a strategic program for research and development of technology related to the exploration, recovery, beneficiation, transportation, storage, and utilization of Alberta's coal resources in a manner that is efficient, economical, safe and environmentally acceptable, in support of the likely pattern of coal development in Alberta for varied uses and markets within the province, Canada and other countries.

(b) providing funding, either wholly or jointly with others, to assist the conduct of appropriate coal-related research and development projects.

(c) with respect to those research activities funded in whole or in part by the Alberta/Canada Energy Resources Research Fund (A/CERRF) program, making recommendations regarding specific research projects and associated funding for review and approval according to the established procedures.

(d) facilitating access to and use of new technology deemed pertinent to the development of the province's coal reserves.

The private sector is expected to provide the initiative and leadership for identifying, managing and carrying out R&D projects and for the subsequent commercial implementation of successful developments. Close collaboration between the research community and the private sector is critical. The support of the research and consulting organizations and the universities toward achieving the goals of the R&D programs identified by the private sector is considered necessary for the future success of coal development in the province.

In addition to the role suggested above, the Universities within the province, ARC and CMRC are uniquely able to contribute to the implementation of this strategic plan and the achievement of its objectives by identifying and conducting research projects considered relevant to the resolution of the major technical problems described herein.

B. THE EXTERNAL ENVIRONMENT

1. Coal Markets

The World Coal Study completed in May, 1980 projected significant growth in international coal trade. At that time, metallurgical coal, which dominated the international trade, was expected to increase by 2.2 times to 294 million tonnes/year by 2000. International trade in thermal coal was forecast to increase by a factor of ten to 686 million tonnes by the same year.

At the time of that study, the world was experiencing the second oil price shock of 1978/79 with oil in short supply and oil prices increasing rapidly. The governments of the major industrial countries were strongly supporting steps to diversify primary energy supply from oil to other sources. Alternatives included natural gas and nuclear energy in addition to coal.

Since the publication of that study, the world wide economic recession has impacted strongly on energy demand, with significant reductions in international demand for metallurgical coal and less than projected growth in thermal coal demand. The current surplus in oil supply and associated weakening of oil price is delaying further commitment to coal burning installations. The major growth projections of the World Coal Study have been superceded by subsequent events.

Today's major markets for metallurgical coal from Alberta are Japan (85%), other countries in the Pacific Rim (9%), Europe and Latin America. Steel production in Japan has dropped significantly during the past two years and recovery is expected to be slow. In addition, major process changes being introduced to the Japanese steel industry are reducing significantly the proportion of coal required for steel production and are resulting in changes to coal specifications and quality. The prospects for significantly increased demand for metallurgical coal in Japan, other countries of the Pacific Rim or Canada are marginal.

The major markets for Alberta's thermal coal exports are Eastern Canada (50%), Japan (37%), and Western Europe. Demand for thermal coal in all of these markets is expected to continue to grow but at a rate lower than forecast a few years ago.

A recent review of Japanese thermal coal demand, the world's major coal importer, has indicated demand for imported thermal coal will expand from 13.5 million tonnes in 1982 to the range of 29-34 million tonnes in 1990. This is significantly lower than previous projections, which were as high as 50 million tonnes. Japan, as other major energy importing nations, does not want to be overly dependent on any one country for its supply of coal. Canada's share of coal imports to Japan are in the range of 10-15% of total supply. Equally important to countries such as Japan is diversification of energy source options. Thus thermal coal in Japan must compete with liquefied natural gas and nuclear power as alternatives to imported oil.

Within Canada, the major markets for thermal coal outside of Alberta and Saskatchewan are in Ontario and the Maritime provinces. Both regions are experiencing reduced rates of growth in electrical power demand and have made major commitments to increased use of nuclear power generation and natural gas, which will further reduce their proportional thermal coal demand.

In addition to the slower growth in coal demand throughout the world, competition for the markets can be expected to increase. The results of significant R&D efforts in other coal producing countries, increasing concerns over the environmental impact of coal utilization, and increasing production and transportation costs will cause coal quality specifications to become increasingly stringent, particularly with respect to calorific content, size consist, sulfur content, and combustion and ash characteristics.

2. Coal Supply

The major coal producing countries in the world include U.S.A., U.S.S.R., the People's Republic of China, Australia, South Africa, Poland, U.K., Germany and Canada. Of these, Australia, South Africa, U.S.A., Poland and Canada supply major quantities of coal into the international market.

Following the optimism resulting from the World Coal Study in 1980 Australia, South Africa, U.S.A. and Canada greatly expanded their ability to produce and export coal. In addition other countries, including Columbia and the People's Republic of China embarked on major coal developments targetted to the international market.

As a consequence of the current expansion of supply and the reduced rate of growth in coal demand, the supply potential for coal exceeds demand. This has resulted in price softening for thermal coal from above U.S.$60/tonne to U.S. $32-35 tonne. Price reductions up to U.S. $15/tonne combined with major cutbacks in actual purchases are continuing for metallurgical coal. Many existing mines have been forced to reduce production and new mine projects are being delayed or cancelled.

The market has become heavily biased in favour of the buyer and fierce competition can be expected between suppliers.

Because of the nature of its deposits and long transportation distances, Alberta is a relatively high cost supplier of coal. Unless significant improvements in coal quality and/or major increases in cost competitiveness for production, preparation and transportation to tidewater can be achieved, Alberta's offshore sales will be limited largely by the customer's desire to diversify its sources of coal supply.

In the countries competing with Alberta for coal sales, significant R&D programs, funded both by the operating companies and governments have been underway for many years. In Australia, cooperative research is carried out by organizations such as the Australian Coal Industry Research Laboratories and the Commonwealth Scientific and Industrial Research Organisation. Similarly in South Africa, coal research is conducted by the National Institute for Coal Research (formerly the Fuel Research Institute) of the Council for Scientific and Industrial Research and the Chamber of Mines. The focus of many of these programs is to ensure the ability of their coals to meet increasingly stringent requirements on coal quality and to improve the yields of saleable coal. As the results of these projects become commercialized, increasing competition can be expected, further limiting the prospects for growth in coal sales from the province.

3. Prospects for Coal Conversion to Liquid Products

The current world oil supply situation coupled with stable or lower prices has reduced the world wide interest in and commitment to coal liquefaction and gasification technology. Additional commercial application of coal liquefaction technologies is unlikely before the next century. Most countries are currently re-examining and consolidating their ambitious research programs in this area. Japan, which is expected to depend on imported oil for greater than 50% of its primary energy demand through and beyond 1990,is reducing its effort on coal liquefaction in favour of other lower cost options including oil shale and tar sands. In the U.S.A., the optimism being experienced last year by the Synthetic Fuels Corporation for coal conversion projects has waned resulting in a revised strategy. U.S. federal funding for coal liquefaction R&D continues to be reduced.

Recent results reported by several research organizations,however, indicate that significantly increased liquid product yields, which should have a major impact in process economics, can be achieved by careful control of the first dissolution stage of direct coal liquefaction processes.

C. THE ALBERTA SITUATION

1. Coal Policy

Alberta has a coal policy which encourages the economic development of its coal reserves by the private sector with minimum government involvement. Before beginning exploration certain approvals are required. Each new project must be approved by the government to assure compatibility with reserves, infrastructure, other developments and environmental requirements.

2. Coal Resources and Reserves

Total coal resources in Alberta are estimated to be 360×10^9 tonnes, of which 81×10^9 tonnes are considered to be potentially recoverable. This latter amount comprises 5×10^9 tonnes in mountain regions, 3×10^9 tonnes in the foothills and 73×10^9 tonnes on the plains.

Marketable coal produced in 1982 was about 20 million tonnes and even if production doubled by the end of this decade, today's potentially recoverable coal would last well over 2,000 years at that rate. Under present circumstances, the largest portion, the plains coals, are generally not exportable.

3. Coal Production

In 1982, approximately 12 million tonnes of subbituminous thermal coal were produced for power generation in the province. In addition about 3 million tonnes of clean bituminous thermal coal and about 3.46 million tonnes of clean bituminous metallurgical coal were produced for export from the province.

4. Future Demand and Production

a. Subbituminous thermal coal

On a tonnage basis, Alberta's coal-fired utilities will continue to have the largest demand for coal; the following table illustrates projected utility coal demand through 1990.

ALBERTA INTERCONNECTED SYSTEM *

Year	Projected Total Installed Capacity (MW)	Projected Coal Fired Installed Capacity (MW)	Estimated Coal Required Tonnes x 10^6/yr
1981	5,475	3,339	11.4
1982	5,475	3,339	12.1
1983	6,110	3,991	13.8
1984	6,504	4,385	15.1
1985	7,187	4,768	15.7
1986	7,187	4,768	16.2
1987	7,570	5,151	16.1
1988	7,976	5,557	16.7
1989	8,325	5,963	17.8
1990	8,208	5,963	18.4

* revised July 22, 1983

The present producers of subbituminous thermal coal are TransAlta Utilities Corporation, Luscar Ltd., and Manalta Coal.

New uses for subbituminous thermal coal may include industrial applications within the province, use in production and/or upgrading of heavy oil and bitumen, conversion to gaseous or liquid fuels or chemical feedstocks, generation and export of electrical power and, if upgraded, export to thermal coal markets outside the Province. In addition to technical or economic constraints, some of these options have economic development policy implications which need to be considered.

b. Bituminous Thermal Coal for Export

Notwithstanding that thermal coal is expected to be the fastest growing sector of an expanding world coal market to the end of the century as many countries attempt to reduce dependence on oil, the short term outlook for increased exports is uncertain. Short term oil surpluses and falling prices have reduced the urgency to convert to coal and lowered the overall growth of thermal coal demand in many countries. There are some indications that export demand will increase in the second half of the decade and beyond.

The anticipated exports of bituminous thermal coal from Alberta during the next five years are:

Year	Million Tonnes
1983	2.9
1984	3.1
1985	4.2
1986	6.3
1987	10.7

These projections have decreased significantly over the past 6-12 months.

The industry continues its strong marketing efforts in the Far East, in Western Europe, Latin America and other regions, with some success. No large increases of exports are foreseen in the next few years, but there is a good possibility of increased sales to the Scandinavian countries, France and Greece commencing before the end of this decade.

Despite the unsettling effects of rapid changes in world oil prices, the coal price manipulations by a few countries which compete for the international thermal coal market, it is clear that Alberta, along with British Columbia, is viewed as a reliable though generally higher cost supplier of coal.

As mentioned in the previous section (External Environment) significant improvement in coal quality and/or major increases in cost competitiveness of Alberta coals will be important if Alberta is to maintain or increase its share of the international market in the future.

C. Bituminous Metallurgical Coal for Export

The weakened international steel industry is unable to accept the quantities of metallurgical coal for which it has contracts resulting in decreased production and layoffs for present producers. Anticipated metallurgical coal exports from Alberta are not expected to increase significantly from the current levels of 4-5 million tonnes/year but there are encouraging indications that, toward the end of this decade, Japan's steel demand may increase. Alberta's opportunities for future exports of metallurgical coal cannot avoid being somewhat depressed by the large export coal developments in Northwestern British Columbia.

Changes in steel production processes are changing the requirements for the quantity, quality and type of coals. Different coals and new coal products such as formed coke may become increasingly important.

5. Coal Research and Development

Alberta has a long history of coal R&D activities primarily through the Alberta Research Council (ARC), and the Energy Research Labs of CANMET (ERL) both in Edmonton and Calgary. The University of Alberta and the University of Calgary have significant activities related to the various aspects of coal including geology, exploration, mining, beneficiation and utilization. The recent establishment of the Coal Mining Research Centre (CMRC) in Edmonton and the redirection and expansion of the coal program of ARC have greatly expanded the coal R&D capability of the province. Several coal companies have significant R&D activities of their own, oriented to solving current operating problems or establishing new commercial opportunities.

The Coal Research Centre in Devon, housing the CMRC, ERL Edmonton, and the coal research activities of ARC, provide one of the finest coal R&D facilities in Canada. A major task of these research groups is to orient and couple their research expertise to the needs, goals and time frame of the private sector.

It is important to realize that, unlike oil sands research and technology development where Alberta is a major player and is providing international leadership, many other significant coal R&D programs have been and continue to be in place around the world.

6. Other Factors Likely to Affect Coal Development

Numerous other factors are expected to impact on future coal development in Alberta including:

a) Future world wide oil and gas supply and pricing.

b) Conflicting expectations regarding land use both on the plains (vs. agriculture) and in the foothills (vs. forestry, fish and wildlife, recreation, etc.)

c) Increasingly restrictive environmental constraints, particularly reflecting concerns over water usage, waste disposal, acid rain, and particulate emissions.

d) Need for and cost of reclamation programs.

e) Development or lack of development of new oil sands production projects to the extent, for example, that coal conversion plants are generally perceived to be a higher cost, higher risk investment than oil sands plants.

f) Uncertainty on the part of the private companies, which are expected to undertake coal development, regarding long term government policy and intentions which affect the viability of various types of projects, including for example, land use and development of subbituminous coal for export as coal, electricity or other derived products. At least one company has established a number of criteria which must be met by all new coal ventures including that the product must be commercially viable, a long term market must be in place and the governments' position regarding taxes, regulatory approval and political will must be known and well understood.

7. Strengths Affecting Alberta Coal Development

a) The Province

Alberta has a private enterprise economy, no sales tax, no inheritance tax, and the lowest personal and corporate income taxes in Canada. Its stable government provides a positive atmosphere for private enterprise and assists and supports the development of coal trade by the private sector. It encourages foreign investment in the coal industry through equity participation or joint ventures with Alberta companies. It promotes R&D leading to the commercial application of better methods of coal production, transportation, utilization, health and safety, and environmental management.

b) Alberta Coal

Alberta possesses about 80% of Canada's coal reserves, more than adequate to satisfy its own needs for many years, and to support long term export contracts without the likelihood of them being curtailed to meet provincial or national requirements. The huge reserves of subbituminous coal beneath the plains are adequate to supply electricity for hundreds of years. They also have promise for conversion to gaseous and liquid fuels and petrochemical feedstocks, and in the recovery and upgrading of Alberta's heavy oils and bitumens, all of which are of potential interest to the province and to export markets in the longer term.

c) The Coal Industry in Alberta

Today's coal industry in Alberta is new, using modern and efficient production technology. It is well managed, does a good job in marketing its product, and has developed excellent relationships and mutual confidence with its present and potential customers.

The coal industry can gain added strength if it is able to develop its mines as early as possible in relation to firm market opportunities, resulting in lower capital costs and more favourable long term economics.

The coal industry also enjoys generally stable relationships with organized labour compared to Australia, its main competitor.

d) Present and Potential Customers

The Alberta coal industry's present and potential customers in the Pacific Rim are very well informed about the province's coal. They have confidence in the coal industry and, despite temporary aberrations in the market, continue to pursue medium and long term supply, particularly

of thermal coal. Even though Australia, South Africa and possibly others may offer similar or better coals at lesser prices, customers generally do not wish to become overly dependent upon single suppliers, and rely with confidence on Alberta and British Columbia for a share of supply. Similar conditions apply to markets in Europe and Latin America. Nevertheless, cost competitiveness will remain a prime consideration in export sales.

e) Transportation

Alberta's export coals are located about 1,300 km by rail from Pacific tidewater and about 2,000 km to the coal terminal at Thunder Bay, Ontario. This fact is a strength in that the problems it creates have been minimized by excellent facilities. However, the distances could become a serious weakness if the capacity of these services is not expanded as required by demand, or if the related user charges are not kept as low as possible, consistent with being fair to the coal producer, the transportation facility, and the customer.

Ocean transportation costs to Pacific Rim customers from Pacific tidewater are about the same as for coals from Australia and can be as low as half the costs for coals from the U.S.A.

8. Problems Related to Alberta Coal Development

a) Development Strategy

The lack of definitive provincial or federal strategies guiding overall economic development, for instance, land and water use, diversification and export of coal derived secondary energy sources, are perceived by the private sector to be major limitations on potential new projects and to have a significant impact on overall risk.

b) Approval Process

Long delays in government approval of coal developments combined with extensive exploration programs and long construction schedules for mine development can lead to higher capital costs, loss of specific markets and a reduction of the industry's ability to compete on world markets.

c) Quality/Cost of Coal for Export

Customers in Japan require thermal coal with a minimum calorific content of 6000 Kcal/Kg and other Pacific Rim countries require a minimum of 6500 Kcal/Kg (10,800 and 11,700 BTU/lb. respectively). The characteristics, of run-of-mine coal in Alberta are such that the yields

of saleable coal can be as low as 50-60%. This results in significantly higher coal cost, both in mining and preparation plant operation. These higher costs, combined with coal quality close to the acceptable minimum, could limit the market share of Alberta coal in international markets to an amount determined largely by supply diversification considerations of its customers.

d) Coal for Use in Alberta

Increasingly restrictive environmental emission requirements could render a significant portion of Alberta's subbituminous coal unusable by Alberta's utilities. Since much of the subbituminous coal lies below good agricultural land the potential conflicts in land use may further restrict coal development. Potential solutions to these problems are likely to increase the cost of coal utilization within the province.

D. OPPORTUNITIES AND PROBLEMS

The coal resources of the province are sufficient to support major expansion of coal based economic opportunities. These opportunities are not without limitations, some of which are significant. The Alberta public is generally supportive of balanced economic development provided it is carried out in a responsible manner.

Current and future economic opportunities for coal based development can be considered in several different categories.

1. Coal for Use in Alberta

a) Opportunities

An expanding demand for electrical power will result in an increasing annual demand for subbituminous coal, currently forecast to be:

1982	12 million tonnes
1985	16 million tonnes
1990	18 million tonnes
2000	21 million tonnes

Certain other industrial based demands for steam raising, the most significant likely to be associated with heavy oil and bitumen recovery, could result in future domestic coal demand in the order of 5 million tonnes annually by the year 2000.

b) Problems

Competing demands on limited water supply and the need to minimize land use conflict, particularly in the agricultural regions of the province, are likely to become increasingly important.

More restrictive emission requirements currently being introduced will impact on the allowable coal quality and could sterilize many subbituminous coal reserves now considered available for use by the utilities in Alberta.

c) R&D Challenges

New methods for reducing atmospheric SO_x and NO_x emissions, even from the low sulphur Alberta coals, are expected to be required. Various approaches to improve combustion efficiency and reduce environmentally unacceptable emissions including coal cleaning methods, improved burner configuration and novel combustion systems, need to be considered.

Land use conflict can be minimized by mining deeper coal deposits either through modified surface mining techniques (up to 200 foot

overburden depth) or underground mining methods. There is a need to increase awareness of current mining techniques and improvements being achieved internationally, followed by adaptation of these to Alberta conditions. Concerns are expressed regarding winter operations and about the ground stability of deeper surface mine operations.

The potential to reduce water and land requirements associated with the production and use of subbituminous coal and with waste disposal must be examined. Further improvements to the methods and costs of land reclamation require continuing study.

2. Thermal Coal for Export

a) Opportunities

Expanded coal sales can be expected from the projected growth of international thermal coal markets and desire of importing countries to diversify supply. The extent of Canada's share will depend on many factors but maximum opportunity for Alberta coal will require improved quality and more competitive delivered coal costs.

Reserves of both subbituminous and bituminous coal in Alberta greatly exceed future Canadian requirements. No government imposed restrictions on coal exports is expected.

Out-of-province demand for Alberta thermal coal is variously estimated to be in the order of:

1984	3 - 4 million tonnes
1990	12 - 20 million tonnes
2000	20 - 26 million tonnes

b) Problems

The international coal market is expected to be increasingly competitive as new suppliers such as Columbia enter the market and existing suppliers work to improve quality and reduce costs. Considerable R&D effort in other countries is being applied to improving the quality of their product and minimize costs.

The higher quality bituminous thermal coals in Alberta are generally difficult coals to mine and clean resulting in higher production costs. The generally high ash and moisture content of the subbituminous coal limitsits potential on the export market.

The long transportation distances through difficult terrain result in additional costs. Capacity of existing or upgraded railways may become a constraint in the longer term.

These factors, in combination, will make it increasingly difficult to maintain existing market share. The possibility of increasing market share is speculative.

The Alberta foothills, where much of the higher quality coals are found, are environmentally sensitive. Public pressure for improved waste disposal and land reclamation procedures can be expected.

c) R&D Challenges

The major challenge for export thermal coal development relates to the need to improve the quality of Alberta coals with respect to energy content, size consist, sulphur content and combustion characteristics as well as its cost competitiveness in the foreign market places.

Several approaches can be considered as part of the solution, including improved mining and short distance materials transport, in-pit crushing, yield improvement in cleaning plants, and upgrading and stabilizing the coal product. Alternate transportation modes with the potential to reduce total transportation cost to shipping terminals need to be identified and evaluated.

The potential for upgrading subbituminous coal to export quality while maintaining the cost advantages, needs consideration. The increasing complexity of new combustion systems requires that coal producers understand the problems being experienced by their customers and that they modify the coal product to reduce or eliminate these problems.

The environmental impact of expanded thermal coal mining, beneficiation and transportation must be reduced or eliminated. Reduced environmental impact should result from the development of means to improve waste disposal and land reclamation. The potential to improve overall economics by achieving a commercial return from preparation plant waste coal needs consideration.

3. Metallurgical Coal for Export

a) Opportunities

The market opportunities for metallurgical coal exports are limited by slow projected growth in international steel demand and new metallurgical coal supply being developed both in Canada and other countries. Certain changes are occurring in the steel production processes including the potential for greater use of formed coke, which are impacting on the desirable characteristics of metallurgical coal. While these changes may enhance the desirability of Alberta low and medium volatile coals, reflecting on these factors and Alberta's more limited reserves of metallurgical quality coal, new or increased trade opportunities appear to be limited at this time.

b) R&D Challenges

Because of the limited opportunities for expanded metallurgical coal sales, only limited R&D effort appears justifiable. Some effort directed toward retaining market share may be warranted but this seems to be within the purview of the coal companies. However the prospects of developing new products or adapting Alberta coals to meet new metallurgical process requirements should be considered. It is recognized that much R&D related to thermal coal is also relevant to metallurgical coal.

4. Coal for Canada's Future Energy Requirements

a) Opportunities

Future Canadian supply of conventional crude oil is expected to decrease. New crude supplies resulting from enhanced recovery of oil from existing fields, development of heavy oil and oil sands deposits and new discoveries in the frontier regions will be increasingly expensive to produce and refine into the required market product. Conversion of coal into selected slates of liquid or gaseous fuels or chemical feedstocks may ultimately result in reducing the total energy supply cost.

Alberta's very large reserves of subbituminous coal and the lack of conflict with other Canadian energy requirements results in a significant international interest in their conversion potential. Indeed, the initial commercial coal liquefaction plants in Alberta may be in response to international demand for coal- derived liquid products rather than Canadian demand. The economic impact of recent improvements in coal- derived liquid yields appears significant and could result in improved competitiveness in the mid to long term.

A unique opportunity results from the close juxtaposition of Alberta's extensive coal deposits and heavy oil and bitumen reserves. In addition to the use of coal as an energy source for the recovery of these heavy petroleum resources, the potential for combined upgrading of heavy oil or bitumen and the liquefaction of coal leading to enhanced products and reduced costs appears possible.

Furthermore, the major growth in electrical power demand based on coal, provides the potential to extract desirable volatile chemicals from the coal prior to combustion.

b) Problems

The current view of coal conversion technology, based on the technical results obtained to date, is that it is more expensive to produce desirable liquid products from coal than other available

resources. This, combined with uncertain future world oil prices and supply, is causing significant curtailment of commercial interest in coal liquefaction and gasification projects. In addition, the extensive oil sands reserves in Alberta provide a realistic option for meeting future liquid fuel demand. Current opinion is that coal liquefaction technology is unlikely to be established on a commercial basis in Alberta during the next twenty years.

c) R&D Challenges

Consistent with the longer term potential for coal liquefaction is the need to establish a data base to permit the assessment by the private sector of the technical and commercial potential for conversion of Alberta coals into desirable liquid fuels or chemical feedstocks to meet forecasted Canadian demand.

Collaboration with other coal liquefaction research groups throughout the world is important to ensure that potential commercial opportunities to develop coal liquefaction facilities in Alberta are not lost to the province.

Investigation and development of novel processes with demonstrable potential for achieving significant technological breakthroughs which would change the commercial prospects for coal liquefaction, should be encouraged.

E. OBJECTIVES, GOALS AND STRATEGIES

1. Objectives

Through private sector/research community/government cooperation, to ensure that the necessary coal-related technologies are available in a timely manner to permit the full economic potential of the coal deposits of Alberta to be realized.

2. Goals

With close collaboration among the private sector, the research community, universities and the government, to identify, investigate and develop those technologies considered likely to be commercially important in the intermediate time frame from 1988 to 1998 and which will:

- enhance the competitiveness of Alberta coals in international markets.
- minimize the environmental impact from the production or utilization of coal in Alberta.
- result in new uses for Alberta coals.

3. Strategies

The Government of Alberta believes that the private sector should have the primary responsibility for ensuring the economic development of the province, and that the private sector involved with the development and utilization of Alberta's coal reserves should take the leadership for the identification and management of appropriate R&D programs and for the final implementation and commercialization of results from such R&D. The role of the Office of Coal Research and Technology, other government agencies such as ARC, the universities, and research organizations such as CMRC is to support the private sector to achieve the necessary technical results in the most efficient manner.

While recognizing the need for both longer term R&D and fundamental research related to a better understanding of coal properties and uses, the critical time frame for commercial expansion and economic development of the province's coal resources is the intermediate five to fifteen year time period from 1988 to 1998 during which time major growth in thermal coal use throughout the world is projected and when increased competition can be expected from other coal exporting countries. Other energy supplies, particularly natural gas and nuclear power, and the relative social and environmental acceptance of coal will have a major impact on the total thermal coal demand during this period.

New R&D initiatives are required now, to ensure that Alberta coal achieves a maximum economic impact during the next fifteen years. Toward this end, the Office of Coal Research and Technology, through the Alberta/Canada Energy Resources Research Fund, has identified initial funding of approximately $20 million in support of agreed research, development or demonstration projects. It is anticipated that similar funding will be forthcoming from the private sector in support of this strategy. Some portion of the funding will be identified for longer term or fundamental research directed toward new and innovative technologies related to the production and use of Alberta coals. Alberta must collaborate closely with research groups in other provinces and countries to ensure that maximum benefit is derived from the total international coal R&D efforts, and to define its intermediate and long term R&D program plans within this context. To accomplish the goals of this Alberta Coal Research Strategic Plan, it is expected that much of the research and development will be conducted, managed and partially funded by the private sector with appropriate technical support provided by other research organizations such as ARC, CMRC, CANMET/WRL and the universities. These latter organizations are also encouraged to propose research projects which are relevant to the resolution of the problems, as described in this plan, limiting the development of Alberta's coal resources.

The Office of Coal Research and Technology has no plans or desire to establish in-house R&D facilities but will maintain a small staff to facilitate the implementation and updating of this Strategic Plan and to administer the ENR or A/CERRF funding provided in support of agreed projects.

Reflecting the diversity of interests and views within the industry about R&D priorities, it has been concluded that the most effective strategy to implement the Alberta Coal Research Strategic Plan is to invite individual companies or groups of companies actively pursuing the development of Alberta coal reserves, to submit proposals directed toward development and demonstration of improved technology which will enhance the competitiveness and efficient utilization of Alberta coals. A major focus of these projects should be directed toward identifying emerging technologies which have potential in Alberta, and adapting these to Alberta coals and conditions rather than attempting to develop unique Alberta technologies. This is likely to be more cost effective, to facilitate technology transfer, and to result in earlier commercial impact. However, the option to support novel approaches which can be shown to hold promise of major significance to future Alberta coal development must be maintained. Toward this end, further discussions are being held with the Universities and research groups such as ARC and CMRC to identify the framework within which such research can be identified, assessed and supported.

Based on numerous discussions, the following potential R&D program areas have been identified with the private sector and the research community.

a) Exploration

A broad based interest exists in the need for improved cost effective geophysical exploration methods which would assist to identify subcrops, the extent of reserves and the in-situ characterization of coal.

There appears to be a potential to develop a multi-sponsored, coal directed geophysical research and development program. A first step toward establishing such a program may require a definitive state of the art review of existing technology to be carried out in collaboration with coal producing or potentially producing companies and geophysical/seismic service companies.

b) Mining

There seems to be a consensus among the private sector that new mining and materials handling techniques will be required for both surface and underground mining operations in Alberta during the next 5-15 years.

The extent to which either R&D or engineering feasibility demonstration projects are required to aid the selection of the most appropriate methods is unclear. Site specific factors may predominate in the selection of particular approaches but certain aspects related to ground stability, and/or winter operations seem to be a general concern. The importance of worker health and safety in new methods must be recognized.

Further clarification is required to determine the need and time frame for the introduction of new mining methods. As an example, the recovery of coal deposits with overburden depths up to 200 feet can impact on land use and mining costs. Future development of high quality plains coal deposits by underground mining may require a long wall demonstration trial by the latter part of this decade.

c) Beneficiation

The R&D potential of this area is considered to be of primary importance to the future prosperity and growth of the Alberta coal sector.

A broad based consensus appears to exist, particularly with respect to thermal coal for export from the province, of the need both to upgrade the product quality, as determined by energy content, sulphur content, and combustion characteristics and to increase the yield of saleable coal. Several companies are supporting a variety of research activities in this area. Fine coal cleaning and dewatering of fine coal and tailings are major con-

cerns related to product cost and yield, as well as the environmental impact of tailings ponds. The potential impact of on-stream analysis and computer based control schemes on these problems requires assessment.

The extent of current R&D activities and the need for further efforts in this important area must be established. The potential for an upgraded form of subbituminous coal to compete successfully in the export markets requires careful analysis. The blending of petroleum coke or the addition of other energy resources to enhance the characteristics of exportable coal needs investigation.

d) Transportation

While projected improvements to the existing railway system are expected to provide the capacity necessary to transport coal for some time to come, the cost of such transportation is a major concern to coal producers and customers. The need to minimize the cost of coal transport is important to future coal sales. Options such as coal slurry pipelining can have a significant impact on the overall utilization strategy for coal, including prospects for coal/water slurry combustion, but must be carefully considered within long term marketing strategies. Other coal transportation alternatives should also be considered.

A need to assess further the technical and economic feasibility of coal slurry pipeline technology for both short and long distance transport is apparent.

Several private companies are taking major initiatives in this area and should be encouraged to assess the potential for various coal slurry pipeline transport modes and develop increased Canadjan technical competence in this field. Collaboration between the various research groups and the other interested parties is necessary to ensure a coordinated national effort directed toward potential commercial exploitation.

e) Utilization and Expansion of Markets

Future growth of coal demand will depend on many factors including growth in total energy demand, and the ability of coal to compete, both economically and environmentally, with other energy resources in traditional applications and in new industrial applications.

Problems associated with substitution of Alberta coal in new industrial applications both in Canada and internationally must be considered. Overcoming problems which limit such substitution could have significant impact on future coal demand. The potential for international collaboration in this area appears high.

While recognizing the importance of research efforts to understand and improve combustion of Alberta coals, many of the coal producers appear to feel that this research should be the responsibility of the end user. However, a collaborative approach combining the capability and knowledge of both producers and users may result in optimizing the match between the capability of Alberta coals and the users equipment and should be encouraged. In a recent address, the President of the Japan Coal Development Company, stated its intent to focus technology efforts on the receiving, distribution and utilization of coal and reflected on the need for an equivalent and collaborative effort on the production side of the coal chain. This should be pursued.

Some interest is expressed in the use of fluidized bed combustion or gasification techniques to recover the energy content of middling and tailing streams, with application to drying of coal or generation of power. An additional benefit of such technology would be to reduce the environmental impact of waste disposal.

Recognizing the importance of coal fired power generation plants to Alberta's future growth, the potential for increasing the combustion efficiency and for reducing undesirable emissions, such as SO_x, NO_x and particulates, associated with the combustion of Alberta coals should be considered. Initiatives by certain companies in this direction deserve careful consideration.

Potential new uses within Alberta which require assessment include the recovery and upgrading of heavy oil and bitumen.

f) Conversion

The prospects for the commercialization of coal liquefaction in Alberta during this century appear limited, hence major direct financial support from the private sector is not expected for coal liquefaction R&D. There is, however, general recognition of the long term strategic potential for this technology. The critical issue to be addressed is the scope of the effort and level of funding which is appropriate, given the current view of future international oil supply and pricing projections and other energy supply options in Alberta. The initial screening of Alberta coals and processes by the ARC is nearing completion resulting in the need to re-examine the direction and scope of future efforts in this area. Consideration should be given to examination of the recent advances being achieved with two stage processing and other technical breakthroughs which are projected to have major impact on the commercial prospects of coal liquefaction. Alternatives include the combined upgrading of heavy oil/bitumen and liquefaction of coal and the extraction of high value volatile chemicals from coal prior to its combustion.

The high pressure facilities now available in Nisku (to be transferred to Devon) allow ARC to participate actively with process developers and other research groups throughout the world. Co-operative programs with these other groups must be encouraged to maximize the benefits to Alberta and minimize the costs to Albertans of maintaining an appropriate level of knowledge of the technology.

g) Reclamation

There is considerable concern throughout the industry regarding the potential financial impact of government imposed reclamation requirements on coal development projects. Focus of concern relates to the prospects for reducing or eliminating tailing ponds and for obtaining a better understanding of the minimum requirements for land reclamation for predetermined uses after mining, particularly when sodic soils are involved.

Efforts should be directed toward assisting coal companies to become more knowledgeable about existing government funded reclamation research programs, potentially leading to expanded co-operation and support.

Research projects directly related to reclamation practice should be submitted to the Alberta Reclamation Research Program.

h) Training of Technical Personnel

The need for technical personnel with a knowledge of coal to support an expanded coal R&D activity and the future application of such results is apparent. The vital role of the universities in the training of highly qualified manpower, the performance of basic research and the general advancement of knowledge is recognized. It is also recognized that there is a range of financial resources available to the universities for the fulfilment of these obligations. While the universities in Alberta have a major responsibility in regard to these activities, research organizations such as ARC, CMRC and CANMET/ERL have expressed an interest in assisting with the training of personnel and are seeking closer collaboration with the universities to accomplish this. These initiatives must be encouraged. Consideration should be given to identifying activities within the scope of selected R&D programs which can be appropriately performed by these groups to enhance the training of additional personnel and to apply the considerable skills of the current staff to important aspects of coal technology.

i) Longer Term Needs

Following identification and selection of industry recommended and supported R&D programs, further consultation and consideration will be given to identify additional R&D areas deemed necessary to achieving the full potential of the province's coal reserves.

F. STRATEGIC PROGRAMS

Following analysis of the issues and concerns identified in the previous sections of this Alberta Coal Research Strategic Plan and discussion with the private sector, research community and government departments and agencies, the focus for development and implementation of improved technology is identified within four strategic program areas. Specific project proposals which fall within the scope of these strategic programs are invited.

Strategic Program Area #1 Coal for Use in Alberta

Major Considerations

S.P. 1.1 To reduce the environmental emissions associated with combustion of subbituminous coal in Alberta, primarily in mine mouth power plants but also future industrial application.

S.P. 1.2 To minimize coal fired electrical power costs while expanding mining operations to deeper surface mineable areas (up to 200 feet of overburden) and other less desirable portions of the deposits.

Secondary Considerations

S.P. 1A.1 To expand the use of low quality preparation plant tailings streams to generate electrical power, thus also reducing the impact of waste disposal in the foothills and mountain regions.

S.P. 1A.2 To expand the use of coal for recovery and upgrading of oil sands and heavy oil and for other industrial applications.

Strategic Program Area #2 - Coal for Export Markets

Major Considerations

S.P. 2. 1 To improve the quality of Alberta coals with respect to increased energy content, size consist, reduced sulphur content, reduced slagging and fouling, and improved combustion characteristics above the minimum acceptable levels (e.g. from 6000 Kcal/Kg to the range of 7000 Kcal/Kg, or higher) with minimal increase in cost thus producing a more desirable export product and indirectly reducing transportation costs.

S.P. 2. 2 To improve the cleaning of thermal coal, particularly the processing and recovery of fine coal, thus improving coal production economics and reducing tailings volumes and associated environmental impact.

S.P. 2. 3 To upgrade subbituminous coal to exportable quality while retaining its relative production cost advantages.

S.P. 2. 4 To investigate options of reducing the cost of transporting Alberta coals to distant markets.

Secondary Considerations

S.P. 2A.1 To reduce the cost and impact of mining and preparation plant waste disposal (see also SP 1A.1).

S.P. 2A.2 To establish means for efficient mining and recovery of deeper thermal coal deposits, both in the foothills and the plains, suitable for surface and, in the longer term, underground mining.

Strategic Program Area #3 - Coal for Future Energy Requirements

S.P. 3. 1 To increase the potential markets and sales of Alberta thermal coals by identifying and overcoming the constraints associated with expanded industrial uses of coal.

S.P. 3. 2 To establish the commercial and technical potential of the advanced processes such as 2 stage liquefaction and co-upgrading of coal and heavy oil or bitumen, for converting the major subbituminous coals of Alberta into selected liquid fuels and chemical feedstocks.

Strategic Program Area #4 - Technology Support

S.P. 4. 1 Development of improved geophysical techniques to reduce the costs of exploration and characterization of Alberta coal deposits.

S.P. 4. 2 Enhance the collection, assessment and distribution of information related to improving the competitiveness of the Alberta coal industry and reducing the environmental impact of coal production and utilization within the province.

S.P. 4. 3 Search out innovative new techniques, which have the potential to give a significant competitive advantage for the production, processing and utilization of Alberta coals.

PART II - INVITATION TO SUBMIT R&D PROPOSALS

G. GENERAL INFORMATION

1. Companies, or groups of companies, active in furthering the development and utilization of Alberta coal resources are invited to submit proposals to conduct research, development or field demonstration projects considered to be important to the company and/or the industry, and which fall within the scope of this Alberta Coal Research Strategic Plan.

2. Expressions of interest and research proposals should be submitted to:

   Registrar
   Office of Coal Research and Technology
   Department of Energy & Natural Resources
   2nd Floor, Pacific Plaza
   10909 Jasper Avenue
   Edmonton, Alberta
   T5J 3M8

3. The Office of Coal Research and Technology will attempt to maintain proposals in confidence but reserves the right to have them reviewed by outside experts when this is deemed necessary. Any confidential information provided in the proposal shall be clearly marked.

4. Periodic projections by the Alberta Energy Resources Conservation Board of in-province energy supply and demand regarding its various energy resources will be taken into account by the Office of Coal Research and Technology, as will projections relevant to Alberta's coal by other governments and energy agencies, as a basis for consideration of financial support of applications for funding.

5. Projects for which the government's share of funding is provided, either all or in part, from the Alberta/Canada Energy Resources Research Fund, must be finally approved by the A/CERRF Committee.

6. The possible need to alter or terminate any approved project to reflect subsequent changes in the Canadian or worldwide energy situation must be recognized and accepted.

H. TYPES OF PROJECTS TO BE CONSIDERED

Within the scope of the Strategic Programs identified in Section F, it is expected that promising new or improved technologies will be at different stages of development. Depending on the current status of these technologies, it is expected that proposals will fall within one or more of the following types of projects.

1. Demonstration Projects

The scale of activities which are necessary to show the technical and commercial feasibility of new technology and to provide the basis for decision to proceed to the major investments associated with scale up and/or commercialization. It is assumed that the maturity of the technology is such that the demonstration scale is warranted. Demonstration projects can include both the adaptation or improvement of known technology to Alberta conditions and the introduction of new technology.

2. Applied Development

The activities necessary to show technical feasibility of new approaches or of the adaptation or improvement of existing technologies to Alberta circumstances.

3. Research Investigations

Generation of technical information to better understand technical aspects of applied development or demonstration projects.

4. Speculative/Exploratory Research

Long term or more fundamental investigation directed toward novel approaches which can be shown to hold promise of major significance to future Alberta coal development.

I. COVERING LETTER

Proposals should be accompanied by a covering letter, signed by a company officer, which will provide:

1. conceptual outline of the ultimate commercial development and target markets in sufficient detail to provide a clear understanding of the proposed project and to demonstrate the need for it

2) a brief statement describing the activities considered necessary, including the timing and total estimated cost, to enable a decision to be made to commercialize the technology

3) information about participating company(ies) including ownership, major business, products, annual report for last two years

4) the applicant's financial capability to undertake its share of the project funding

5) the company(ies) interest in and financial capability to commercialize potential results of project including construction and/or operation of commercial facility

J. REVIEW AND SELECTION OF PROPOSALS

1. A two stage process will be used for selecting proposals. The first stage will be to assess the significance of the proposed project. Proposals which fail to pass this first screen will not be considered further and the applicant will be so advised. The second stage for those projects which pass the significance criteria, will be to assess the proposed project plan. Applicants are encouraged to address each factor in their proposal. Discussions between the Office of Coal Research and Technology and the applicant to refine the details of the proposal may be required.

2. In the first stage, the significance of the proposed project will be assessed against the following criteria, in order of weighting:

a) Compatability with the Alberta Coal Research Strategic Plan

i. the type of project (reference section H)

ii. proposals should fall within the scope of one or more of the strategic program areas identified in Section F

iii. proposals should be supportive of the goals and objectives identified in Section E

b) Commercial significance

i. the potential market opportunities or commercial application

ii. the competitive situation

iii. the commercial benefit to be derived from successful development

iv. the competitive edge resulting from successful development

v) performance targets in relation to the commercial benefits

vi) the rate at which technologies can be developed and commercialized relative to the time required for commercialization and subsequent realization of the expected benefits

vii) the need for further development in other parts of the "coal chain" to facilitate or permit the commercialization of the proposed technology

c) Technical Significance

i) the nature of the technical problems to be resolved in the light of current knowledge and related R&D currently underway

ii) the need for the proposed work

iii) technical performance parameters which should be consistent with the expected commercial and financial goals

iv) the potential to generate valuable proprietory or patentable know-how

d) Financial/Economic Significance

i) the potential financial return resulting from the successful development and commercialization

ii) cost and/or other significant financial targets

iii) the potential economic benefits to the Province of Alberta including the possible impact on other sectors of the economy, including related new manufacturing or production opportunities

e) Risks

i) the perceived technical and commercial risks which should be higher than those which can be reasonably expected to be carried by the applicant

ii) the nature and magnitude of the risks

f) Funding

i) the relative share of government funding being requested should reflect the risks and the importance of the proposed development

g) Social Benefits

i) the importance of successful development to the general public in Alberta including aspects such as job creation and reduction of public concerns regarding coal development and utilization

h) Success

i) the probability of both technical and commercial success

j) Terms and Conditions

i) any major concerns with the general guidelines for the research agreement identified in Section M should be addressed including suggested changes and/or additions

3. In the second stage, the project plan will be assessed against the following criteria:

a) Approach

i) the proposed technical approach which should be compatible with achievement of the technical objectives and demonstrate an understanding of the problems to be resolved and take account of other relevant R&D activities

ii) identification of key milestones and decision points Where possible, a phased approach is preferred

iii) Alternative approaches which were considered

b) Work Plan

i) the work plan describing all major activities, the necessary resources including personnel, and their required qualifications, equipment and materials

ii) a schedule showing the major activities and key milestones or decision points

iii) the planned project management structure

c) Capability

i) the degree of availability and identity of the necessary staff with appropriate and demonstrable experience, equipment and other facilities

ii) whenever possible and practical, Alberta based or Canadian based resources including personnel, equipment and material suppliers should be used. Any necessity to use non-Canadian based capability should be described

iii) the extent to which the proposal builds on existing knowledge, facilities and expertise

d) Budget and Source of Funds

i) costs identified by major task and as direct salaries and benefits, materials and supplies, outside contracts, travel, overhead (% of direct salaries) and equipment

ii) the source of all funding

iii) any areas of uncertainty in budget projections should be identified

K. PROJECT MANAGEMENT

The overall approach, implementation plan, schedule and budget will be agreed between the applicant and the Office of Coal Research and Technology. The applicant is expected to exercise the primary responsibility for day to day management of the project, with regular periodic reporting requirements to the Office of Coal Research and Technology and joint reviews of progress.

L. FUNDING

1. The current economic climate and financial position of the the coal industry demands considerable flexibility in funding approaches, but it is generally assumed that the applicant and the Office of Coal Research and Technology will share the project cost.

2. The relative share of costs should approach 50/50 over the life of the project, and reflect the technical and commercial risks and the confidentiality and rights for use of the technology being developed.

3. Office of Coal Research and Technology funding significantly greater than 50/50 will reflect more flexible disclosure terms and higher technical risks.

M. AGREEMENT

Funding for approved programs will be provided under the terms and conditions of a negotiated agreement signed by the participating parties. The specific terms and conditions are expected to reflect the following general guidelines:

1. Funding

Funds are paid upon receipt of invoices and a statement of services performed. There may be a hold-back of 10% of funds until the final report has been received and accepted. All expenditures will be subject to audit by provincial authorities. A specimen agreement will be forwarded to applicants upon request.

2. Performance of Work

The applicant shall perform the work under the general guidance of a mangement committee with representatives of each of the funding parties, but shall have the status of an independent contractor.

The work is to be conducted primarily in Alberta, although use of expertise not resident in Alberta is permitted when such expertise is clearly required for effective operation of the project. If there is an ongoing need for such non-resident expertise, then efforts should be made to establish such expertise within the Province.

Work should not duplicate that carried out in other projects funded directly or indirectly by government or work being done by other research organizations.

3. Project Alterations

An approved project shall not be altered in any way (e.g. in terms of objectives, subject matter, shift in emphasis, etc.) from the written proposal without prior written agreement from the Office of Coal Research and Technology. It is expected that an applicant will make every reasonable effort to meet all objectives proposed.

4. Financial Records and Reports

The applicant shall maintain complete and accurate financial records and shall provide the Office of Coal Research and Technology reasonable access to such records. The applicant shall submit financial statements at least quarterly as well as an audited statement annually and as part of the annual report.

5. Surplus Funds

If the funds awarded are not completely expended for a project, any remaining funds must be returned.

6. Technical Reports

A detailed technical report on the status of the work will be required at least semi-annually, as well as a complete and detailed technical report at the conclusion of each project. Progress reports will be submitted on a regular basis as agreed.

7. Final Report

The final report must be submitted to the Office of Coal Research and Technology within a reasonable time after the project is complete.

8. Acknowledgements

All final reports and publications should acknowledge the support given by A/CERRF.

9. Access to the Work

Authorized representatives of the Office of Coal Research and Technology shall have reasonable access to the work during the funding period.

10. Ownership/Confidentiality/Use of Technology Development by Project

The conditions of confidentiality, ownership and use will generally reflect the following principles:

(a) Ownership of Technology

The Office of Coal Research and Technology will own all technology funded on 50/50 basis or greater.

(b) Confidentiality

Each party agrees to hold both prior and project technology confidential for a fixed time, unless mutually agreed to do otherwise.

(c) Royalty-Free Use

Contractor(s) to have royalty-free use of the project technology in Alberta (or Canada). Use outside of Alberta will require Office of Coal Research and Technology approval and will normally result in establishing and implementing a mutually acceptable royalty rate.

(d) Licensing or Sale of Project Technology

The Office of Coal Research and Technology will have the right to license or sell the project technology to third parties, but will consider and recognize the commercial interests and intents of contractor and its diligence in pursuing commercial development in Alberta. The contractor has right to sublicense on terms mutually acceptable to it and the Office of Coal Research and Technology.

(e) Sharing of Revenues

Any revenues resulting from the licensing or sale of project technology will be shared between the parties on the basis of funds contributed to the project by each party. Engineering, preproduction and marketing costs are not included. Value can be assigned to the costs of developing prior technology.

11. Liability and Indemnity

The Office of Coal Research and Technology shall be indemnified by the applicant against any claim whatsoever, including claims related to patent infringement.